	3	0
	4	5.59
	5	5.58
	6	6.68
	7	6.07
	8	6.75
U2	1	1.27
	2	1.27
	3	0
	4	5.97
	5	5.58
	6	6.68
	7	6.07
	8	6.91
U3	1	0
	2	3.64
	3	7.62
	4	1.75
	5	1.73
	6	0
	7	1.36
	8	1.36
U4	1	13.88
	2	0
	3	7.98
U5	1	1.42
	2	0.82
	3	0
	4	6.35
	5	13.86
U7	1	1.41
	2	1.41
	3	0
	4	5.52
	5	5.53
	6	6.66
	7	5.98
	8	6.72
U8	1	7.98
	2	7.98
	3	7.97

	4	0
	8	13.88
Q1	S	0
	G	0
	D	7.91
Q2	S	0
	G	0
	D	7.90
Q3	E	7.99
	B	7.98
	C	0
Q5	S	6.72
	G	13.84
	D	0
Q11	S	6.72
	G	13.92
	D	6.73
Q12	S	1.94
	G	0
	D	7.98
Q17	S	5.56
	G	3.42
	D	5.56

Conditions: Transmitting, no audio, 14.07V power supply, DVM.

U6	1	1.40
	2	1.40
	3	0
	4	5.06
	5	5.02
	6	6.16
	7	5.49
	8	6.21
Q6	E	0.53
	B	1.19
	C	13.0

Q7	E	0.084
	B	0.74
	C	13.66
Q8	E	1.08
	B	1.82
	C	13.67
Q10	E	0
	B	0.78
	C	0
Q13	S	1.73
	G	0
	D	7.41
Q14	S	0
	G	0
	D	7.40
Q15	S	0.92
	G	7.40
	D	0.92
Q16	S	0
	G	7.36
	D	0

2. Check BFO and LO Signal Sources:

Measure TX BFO injection level U2 pin 6:
175mV rms TX, PTT closed
Measure TX VFO injection level U6 pin 6:
175mV rms TX, PTT closed
Measure RX BFO injection level U1 pin 6:
175mV rms RX
Measure RX VFO injection level U7 pin 6:
175mV rms RX
Measure 20M BFO frequency:
8998.0KHz typical
Measure 75m BFO frequency:
9001.0KHz typical
Measure 20M VFO band limits:
5.15MHz to 5.35MHz
Measure 75M VFO band limits:
5.05MHz to 5.25MHz

3. Trace Receiver signal path with a 5mV rms signal at the antenna jack.

RX Mixer 1 output at U7 pin 4:
100mV rms
IF filter output at U1 pin 1:
50mV rms
RX Mixer 2 output at U1 pin 4:
6mV rms DMM only AC V
AF pre-amplifier output at U8 pin 1:
120mV DMM only AC V
AF power amplifier output at U5 pin 4:

AF output at speaker jack:

AGC voltage at Q17 gate:

4. Additional Reciver Checks

IF Bandwidth:
2900Hz at 6dB (1/2 voltage) points
RX DC current drain:
65mA

5. Trace Transmitter Signal Path

Press PTT switch and whistle into mike.
Note: values measured Voltage peak to voltage peak, divide by 2.8 to compute RMS value.
Mic bias at J1 pin 2:
2 volts DC
Mic pre-amp output at Q12 source:
50mV
Mic amplifer outut at U3 pin 8:
400mV
TX Mixer 1 audio injection level at U2 pin 1:
150mV

Mic amplifier output

TX Mixer 2 output level at U6 pin 5:
300mV
TX amplifer output at Q13 source:
300mV
TX Spur Filter output level at Q6 base:
200mV
TX Buffer amplifier output at Q8 base:
1.5V
TX Drive amplifier output at Q7 base:
3.0V

TX PA output J4 pin 5:
45V
TX output at antenna jack:
40V

6. Additional Transmitter Checks

TX 12V current drain on voice peaks:
1.7A
TX 12V current drain PTT close, don't talk:
290mA

CASCADE OPTIONS:

17M / 40M Conversion

The first option describes circuit value changes to put the rig on 40 and 17 meters. This modification is complex, seek the help of an experienced member if you're unsure.

Several changes need to be made; VFO and BFO, IF crystal filter, Low pass filter, TX spur filter, and RX pre-selector filter. You will need two blank 20M bandmodule boards, or with some reworking, 2 blank Sierra band module boards.

I'd make sure the rig works as it should on 75/20 meters, then rework the rig to operate on 17/40M. This approach is a lot more time consuming but you'll know that everything else works before starting to change all the filters.

12.288MHz Crystal Filter

The IF crystal filter changes from a 9MHz to a 12.288MHz center frequency. You'll need to buy 10 to 12 crystals from Digikey. Next measure each crytal's series resonate resistance, and frequency shift values. G3UUR describes how all this is done in a recent (June, 1995 ARRL QEX) article titled "Refinements in Crystal Ladder Filter Design" by Wes Hayward

The filter article shows how to calculate the motional capacitance and Q values needed to design a filter. I used Wes Hayward's filter program to designed a Butterworth SSB filter using the following crystal parameters. Confirm your measured crystal nominal parameters are similar.

Case HC49/U ONLY
F-series = 12.288MHz
R-series = 15 ohms
L-motional = 0.0063H
Cp = 5pF
Q = 31,000

Select 5 crystals from your batch of 10 crystals that match within 150Hz. The 12.288 MHz filter's 3dB Bandwidth is 2700Hz and the R-termination 750 ohms.

Component value changes:
Y2-Y6 HC49 12.288MHz crystals
C77, C81 47pF 5% silver mica
C79 39pF 5% silver mica
C78 C80 68pF 5% silver mica
C82,C83 120pF 5% silver mica
Cin Cout 10pF 5% ceramic
(Add Cin and Cout to input and output of filter, shunts to ground)

TX Low Pass Filters

Use 20M bandmodule board

	40M	17M
C12,C16	390pF	180pF5% 200V cer.
C15	820pF	330pF5% 200V cer.
L2, L3	T37-2 18T	T37-6 14T
	1.36uH	0.57uH

RX Pre-selector Filter

Use 20M bandmodule board

	40M	17M
L1	FT37-61 16T	T37-6 24T
	14uH	1.7uH
T1	FT37-61 16T	T37-6 24T
	14uH	1.7uH
	Primary 1T	Primary 2T

TX Spur Filter

Use 20M bandmodule board

	40M	17M
L4,L5	T37-2 16T	T37-2 16T
	1.02uH	1.02uH
C3,C11	330pF	180pF 5% ceramic
C4,C10	100pF	22pF 5% ceramic
C7	22pF	2.5pF (two 5pF in series) 5% ceramic
C5, C9	330pF	22pF 5% ceramic

Bandwidth:

400KHz	800KHz

R-terminations:

50 ohms	50 ohms

BFO

Y1 change to 12.288MHz Crystal

5MHz VFO

To tune the 40M phone segment with a 12.288MHz IF, the VFO needs to shift down slightly. For the 17M phone segment, the VFO needs to shift up 850kHz. Since the 17M phone subband is only 58kHz wide the tuning range is also reduced from 200kHz to 60kHz.

40M VFO

4.988MHz to 5.138MHz
J4 pins 25 to 23 SHORTED

17M VFO

5.822MHz to 5.880MHz
J4 pins 25 to 23 OPEN
L1 No change 5.1uH 33T total T50-7 Tap at 8T
C22 now 47pF ceramic NP0
C34 add 220pF ceramic NP0 in parallel
C89 not used short with wire
Connect J4 pin 23 ground return to junction of C22 and C25 NOT to ground. This pad is just to the left of trimmer C34, cut away ground and re-connect.

VFO Aligment:

1. If possible measure L1, should be 5.1uH
2. Install 40M bandmodule board with J4 25 to 23 shorted
3. Set C18 to Fully meshed position
4. Measure VFO frequency using station reciever, should be around 4.988MHz. Write down the frequency.
5. Remove 40M band module board
6. Subtract 850kHz from frequency in step 4. Adjust C34 so the VFO now oscillates at the new higher frequency.
7. Reinstall the 40M band module board. Adjust C17 to reach 4.988MHz. Add additional shunt C to C17 to reach 4.988MHz if frequency is too high. Start with a small amount, i.e. 10pF NP0.
8. Check tuning range on 40M is at least 200kHz, Check tuning range on 17M is at least 60kHz.